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Nutrient charting

Nutrient charting is a powerful tool for managing the nutrition of nursery crops. Even though the procedures are quick, inexpensive and can be done on site, nutrient charting can provide valuable early warning of nutritional disorders. The procedure is based on 'quick tests' to interpret key nutritional trends in the plant or growing media, which are easily measured at regular intervals over the life of the crop. This *Nursery Paper* explains what nutrient charting is, the tests involved and how to interpret the results.

When a crop is given too little water, there are several obvious signs:

- Pots feel lighter.
- Plants wilt.

Once noticed, the problem is usually easily rectified with irrigation.

When a crop receives too little fertiliser, the visible signs of the problem often appear too late for the grower to prevent loss.

These problems must be identified before they become chronic.

Nutrient charting

Nutrient charting is a way of obtaining early warning signs of nutritional disorders. It can be used to:

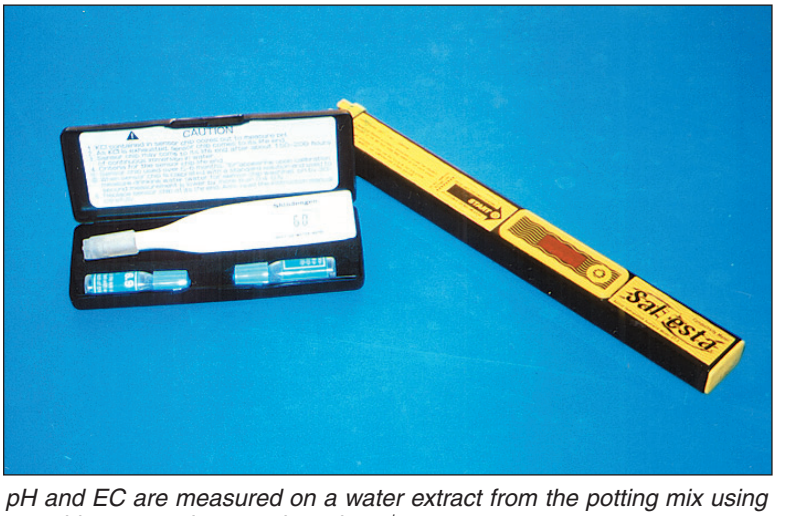
- Anticipate deficiencies and toxicities so that they can be corrected before they become chronic.
- Check on the adequacy of a fertiliser program and guide the development of a new one.
- Indicate when a crop needs top dressing.

The procedures are quick, inexpensive and can be done on site. Interpretation of results is intuitive making the user less dependent on outside advice.

Nutrient charting differs in three ways from traditional plant and media testing:

1) The procedure is prognostic rather than diagnostic. Problems are anticipated rather than identified after the fact.

2) The procedure is not dependent on published standards. Nutrient trends are as important as actual values for interpretation.



pH and EC are measured on a water extract from the potting mix using portable meters that cost less than $200.

3) The procedure is uncomplicated and can be based on inexpensive tests (quick tests) that can be done on site. The production manager is less dependent on external advice for interpretation.

Quick tests

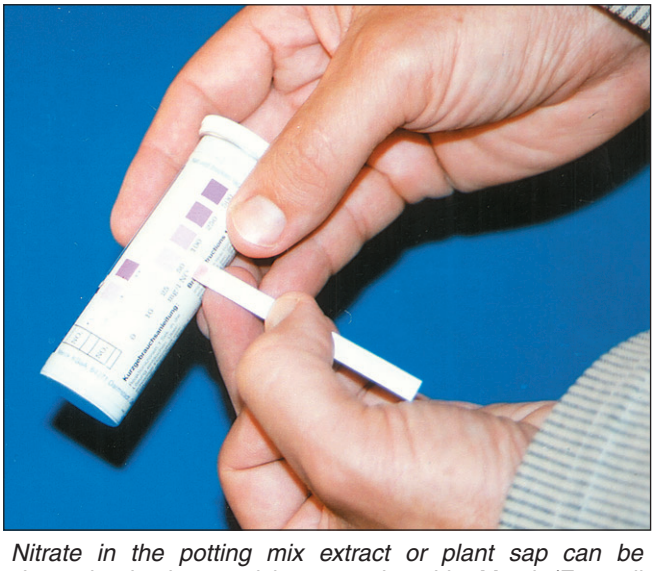
Conventional leaf and soil analysis can be used but are generally too slow and expensive for most nursery crops.

Fortunately, there are now several reliable and inexpensive chemical tests that can be done without laboratory facilities. These are simple enough to be mastered with only a few minutes of instruction.

The most useful tests are:
- Potting mix – pH, EC (electrical conductivity) and nitrate.
- Plant sap – nitrate.

There are many different types of pH and electrical conductivity (EC) meters available, which vary in cost and reliability.

There are two types of nitrate strips available:
- Merckoquant strips are read by comparing the developed colour with standards on the side of the container.
- Reflectoquant strips are read using an electronic device (RQflex reader) that costs around $2000. The reader gives a more precise value than can be obtained by eye with the Merckoquant strips.



Nitrate in the potting mix extract or plant sap can be determined using a quick test produced by Merck (Freecall 1800 335 571). This is based on a colour reaction in a chemically impregnated paper strip that costs about $1 a test.

Several other nutrient tests are available in this range including NH_4, P, Ca, K and Fe. Potassium can also be reliably determined using a Cardy meter available from Australian Scientific, Newcastle.

Sampling of leachate

For weekly monitoring of crops where it is clearly undesirable to sample destructively, the pour-through technique is the most practical way of sampling the soil solution.

Because the quantity and composition of the leachate can be easily influenced by the way the sample is taken, it is very important that the sampling procedure is followed rigidly. Ideally, the same person should always do the test.

Pour-through technique

1. Label three representative pots.
2. Return the pots to the production area spacing them out to cover some of the variation in growing conditions. Do not put them together as this will make your measurements less representative of the group.
3. Every week, one hour after the mid-day irrigation collect the labelled pots and place each in a clean saucer.
4. Pour 100ml of fresh water over the surface of the media in each pot and collect the resulting leachate (approx. 70ml). Apply the water slowly and evenly to prevent channelling of water through the mix or down the sides of the container as this will dilute the leachate. The water is intended to displace the soil solution in a process called piston flow. If too much water is applied, the leachate will also be diluted.
5. Pour the leachate from the three saucers into a clean jar.

Testing

1. Swirl the leachate in the jar to be sure it is adequately mixed.
2. Tests for pH, EC, N, P and K can be done directly on the undiluted leachate.

NOTE: If the concentration in the solution is over the test range, the sample can be diluted.

1. Measure out 10ml of leachate using a disposable syringe or medicine glass and mix with 10ml of fresh water in a clean vessel.
2. After testing this solution, remember to multiply the result by two to adjust for the dilution.

Plant sap

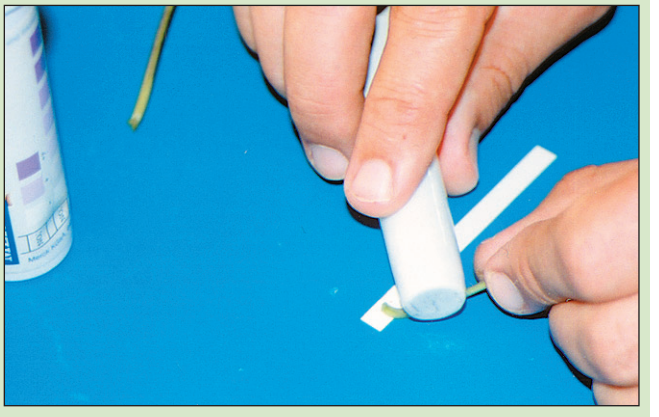
There is little published on how to collect sap from ornamental plants and so you may have to experiment to find a suitable method for each crop. The following information is provided as a guide for the collection of sap from fleshy plants.

Plant sap option 1 – Based on Reflectoquant strips and reader

1. Collect the petiole from several recently mature leaves.
2. Cut into 10mm lengths and place in a garlic press.
3. Express at least 1ml of sap into a clean container.
4. Using a pipette or syringe transfer 1ml of sap into a vessel containing 10ml of distilled water.
5. Mix and determine the nutrient composition of the solution.
6. Dilute the solution further if the test result is too high.
7. Multiply the test result by 11 to find the true concentration in the sap.

Plant sap option 2 – Based on Merckoquant nitrate test strip

1. Collect three or four recently mature leaves.
2. Place the cut end of a petiole on the test strip and express some sap by rolling a pen along its length.



Extracting sap from a petiole by rolling a pen along its length.

3. The nitrate concentration of the sap can be estimated in one of two ways:

From the intensity of the colour after 1 minute, if it is within range.

From the time taken for the full colour to develop (refer to Figure 1), if it is above range.

4. Test and record results for each leaf.

Record keeping

Record the date, the time, the location and each result in a book and plot the data on a chart with 'Days from planting' on the x-axis and a suitable concentration range on the y-axis. These types of charts are easy to produce using a spreadsheet program like Excel.

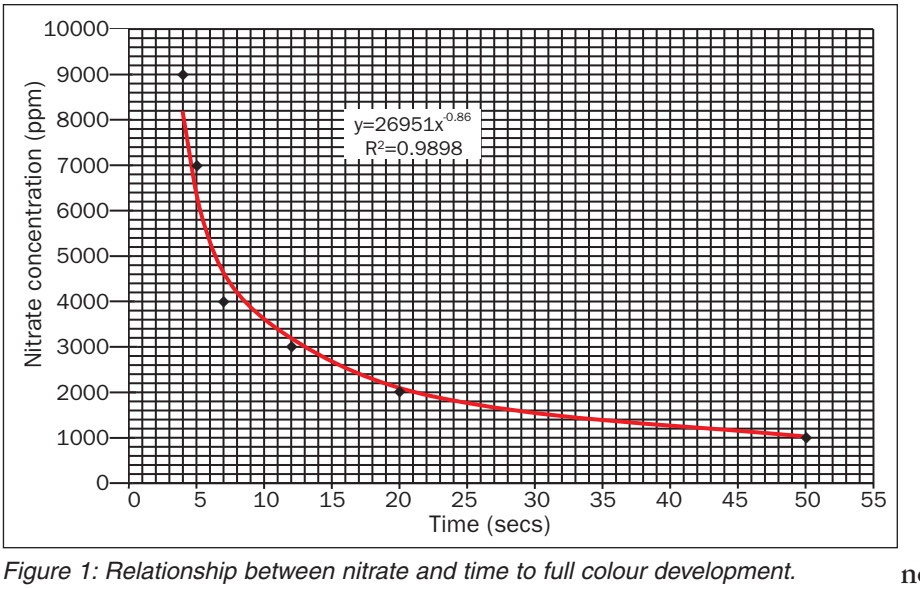


Figure 1: Relationship between nitrate and time to full colour development.

Interpretation

There are three ways of interpreting test results:

- By comparing values to published standards. Broad guidelines are available for nitrate and EC in potting mixes (Tables 1-3). Very little information has been published on critical levels for nitrate in plant sap (Table 4).

- By comparing good and poor crops. This is easy if they are growing at the same time. If not, records for an earlier crop

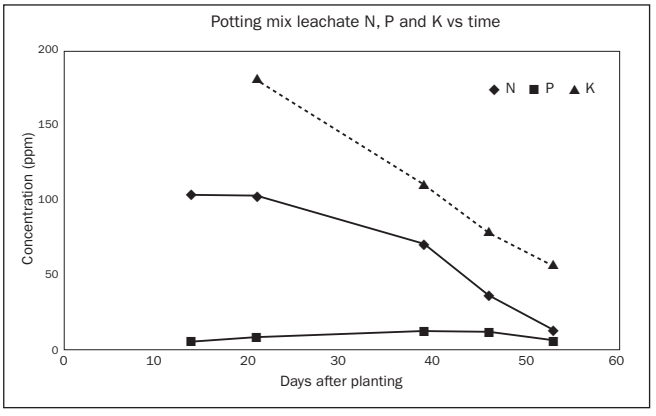


Figure 2: Potting mix leachate N, P and K vs time.

can be used. Eventually it will be possible to develop an ideal trend for certain crops which can be used as a management template.

• By examining trends. This is an intuitive process. Rising trends indicate that supply exceeds plant requirement and point to a possible toxicity in the future while falling trends indicate the reverse and the possibility of a deficiency.

Table 1: Nitrogen guidelines for plants with moderate to high nutrient requirement (Yeager et al, 1994)

Pour-through Nitrate-N ppm	Pour-through Nitrate ppm	Nitrogen status
<40	<177	Low
40 – 65	177 – 288	Acceptable
65 – 85	288 – 377	Optimum
85 – 150	377 – 665	High
>150	>665	Very high

Table 2: Optimum nutrient ranges for potting mix 1:1.5 and pour-through extracts

Element	1:1.5 (Handreck & Black, 1994) ppm	Pour-through (Yeager et al, 1994)
Nitrate	>222	288 - 377, >50[a], 75-100[b]
Phosphorus		8 - 12, 10-15[b]
Potassium		20 – 50, 30-50[b]
Calcium		20 – 40, 10-15[b]
Magnesium		15 – 20, 10-15[b]

[a] 50ppm nitrate may be acceptable where CRFs are used (Handreck & Black, 1994).
[b] Levels promoting vigorous growth in Ilex crenata (Wright, 1984).

Table 3: Guidelines for using EC to decide when to fertilise woody plants of moderate salinity tolerance (After Handreck and Black, 1994 and Yeager et al, 1994)

1:1.5	Pour-through dS/m	Action
<0.35	<0.7	Fertilise if CRF is finished and nitrate is low
0.35 – 0.7	0.7 – 1.0	Acceptable for CRF Check nitrate
0.7 – 1.3	1.0 – 1.5	Optimum
1.3 – 1.8	1.5 – 3.0	Do not fertilise or allow the mix to dry
>1.8	>3.0	May be too high. Leach with fresh water

Table 4: Suggested guidelines for nutrients in plant sap (Extracted from de Kreij, 1993)

Crop	Nitrate	P ppm	K ppm	Ca ppm
Rose	>500	550	5700	320-600
Azalea	2000			
Gerbera				320-760
Poinsettia	>800	680	4400	1100
Carnation				200-500
Begonia	>800			
Cyclamen	1000-2000			
Geranium	4500-8000			
Saintpaulia	3000-4000			

The bottom line

Nutrient charting is a tool which can assist nursery managers answer those fundamental questions about fertiliser use: what product to use, how much to apply and how often? These choices are important because they impact on the growth, quality and disease susceptibility of plants and on the environmental credentials of a nursery.

Acknowledgements

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